Protein Synthesis and Gene Expression

Sep 29-8:41 PM

DNA stores information in a code comprised of base pairs.

Proteins are made from 20 different kinds of amino acids
- When amino acids link together they form polypeptides.

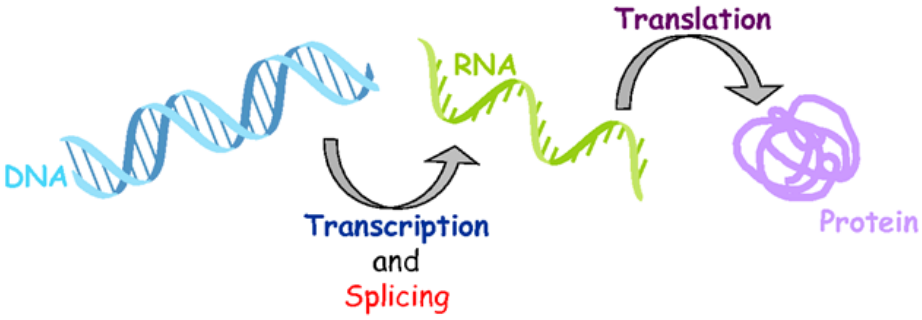
Each different type of protein contains a different combination of the 20 amino acids.

Gene Expression - a term used to describe the transfer of genetic information from DNA to protein

Sep 29-8:49 PM

Gene expression

From Gene to Protein



EURASNET

Sep 29-8:59 PM

It take a combination of three nucleotides (a codon) to represent one amino acid.

More than one codon can code for the same amino acid

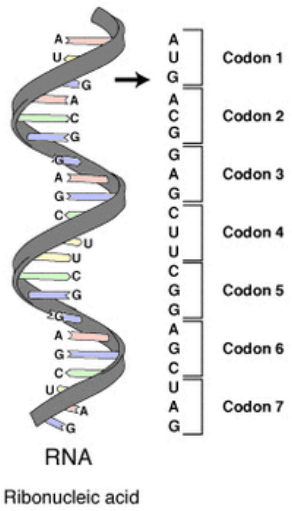
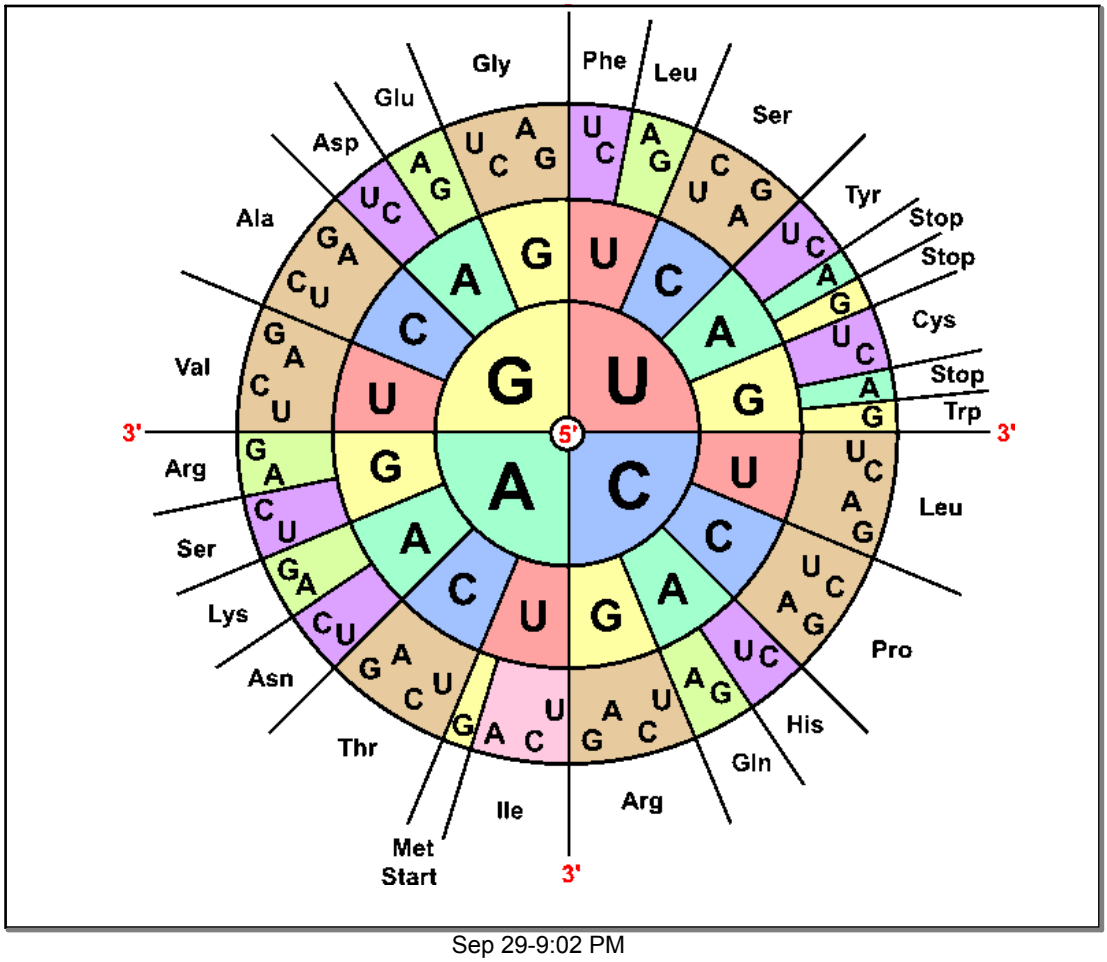


Table of mRNA codons

First Base	Second Base U	Second Base C	Second Base A	Second Base G	Third Base
U	phenylalanine	serine	tyrosine	cysteine	U
	phenylalanine	serine	tyrosine	cysteine	C
	leucine	serine	STOP	STOP	A
	leucine	serine	STOP	tryptophan	G
C	leucine	proline	histidine	arginine	U
	leucine	proline	histidine	arginine	C
	leucine	proline	glutamine	arginine	A
	leucine	proline	glutamine	arginine	G
A	isoleucine	threonine	asparagine	serine	U
	isoleucine	threonine	asparagine	serine	C
	isoleucine	threonine	lysine	arginine	A
	START methionine	threonine	lysine	arginine	G
G	valine	alanine	aspartate	glycine	U
	valine	alanine	aspartate	glycine	C
	valine	alanine	glutamate	glycine	A
	valine	alanine	glutamate	glycine	G

Sep 29-8:59 PM



Sep 29-9:02 PM

RNA codons are written in the 5' to 3' direction

Only three codons don't code for an amino acid. These are stop codons (end protein synthesis)

Sep 29-9:04 PM

Transcription

- makes an accurate copy of a small piece of an organism's genome.

- transcription begins at the TATA box (initiation site on the DNA strand)

- the information is copied onto messenger RNA (mRNA).
    - carries information from DNA in the nucleus to the protein synthesis machinery of the cell.

- this reaction is catalyzed by RNA polymerase

- only one strand of the DNA is transcribed (the sense strand)
    - the other strand = the anti-sense strand

Sep 29-9:08 PM

RNA polymerase opens a section of the double helix and works its way along the sense strand creating an RNA strand complementary to the DNA strand.

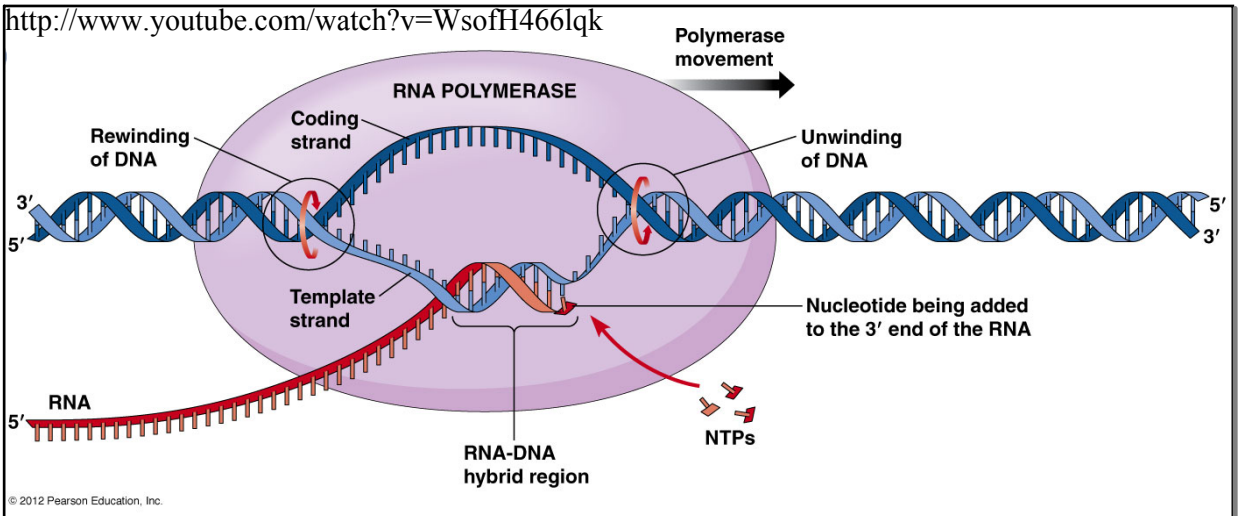
- RNA polymerase elongates the mRNA in the 5' to 3' direction.

- As the RNA polymerase passes, the DNA helix reforms and the mRNA strand separates from its template DNA strand.

- RNA polymerase will follow along the sense strand until it encounters a stop signal

Sep 29-9:13 PM

http://www.youtube.com/watch?v=WsofH466lqk



Enzymes will remove the introns (non-coding nucleotide sequence) from the intial mRNA transcript and splice together the exons (instructions for protein synthesis)

The mRNA molecule is then packaged and transported from the nucleus to the cytoplasm

http://www.youtube.com/watch?v=WsofH466lqk

Sep 29-9:20 PM

Translation

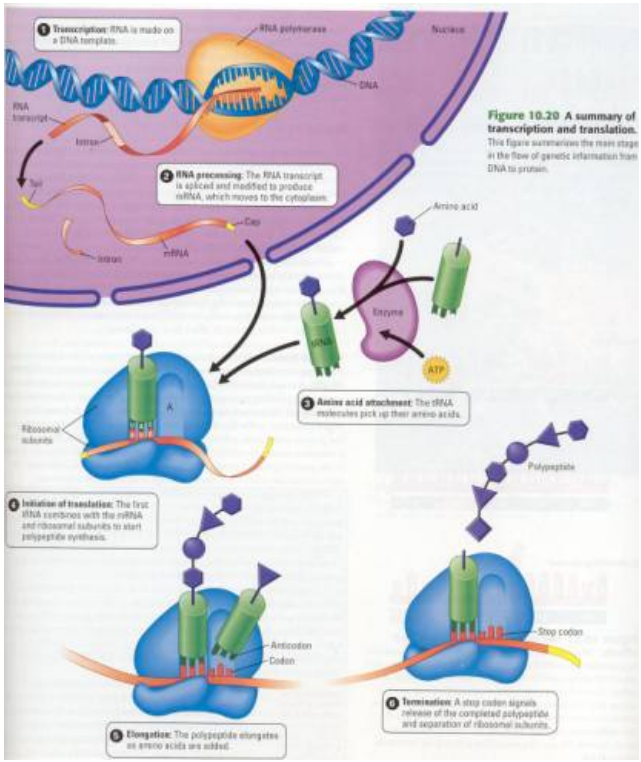
Transfer RNA (tRNA) link each codon on the mRNA to its specific amino acid.

tRNA is shaped like a cloverleaf

- one lobe contains the anticodon - nucleotide triplet with a sequence that is complementary to the codon of the mRNA.

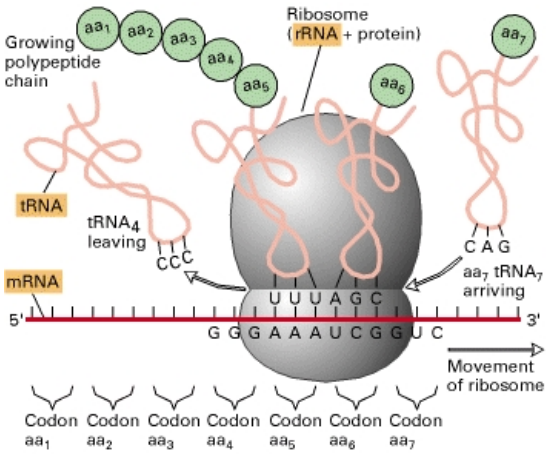
example: tRNA with the anticodon sequence GGU will bind to the amino acid serine and will carry this amino acid to the mRNA codon CCA.

Sep 29-9:22 PM



Sep 29-9:28 PM

Ribosomes consist of two subunits (large and small) that made of proteins and RNA (rRNA). Ribosomes are responsible for bringing together the mRNA strand, the tRNA molecules carrying the amino acids and the enzymes involved in building polypeptides (long chains of amino acids - proteins)



Oct 1-8:42 PM

The Translation Cycle

- initiated when an mRNA molecule binds to a ribosome

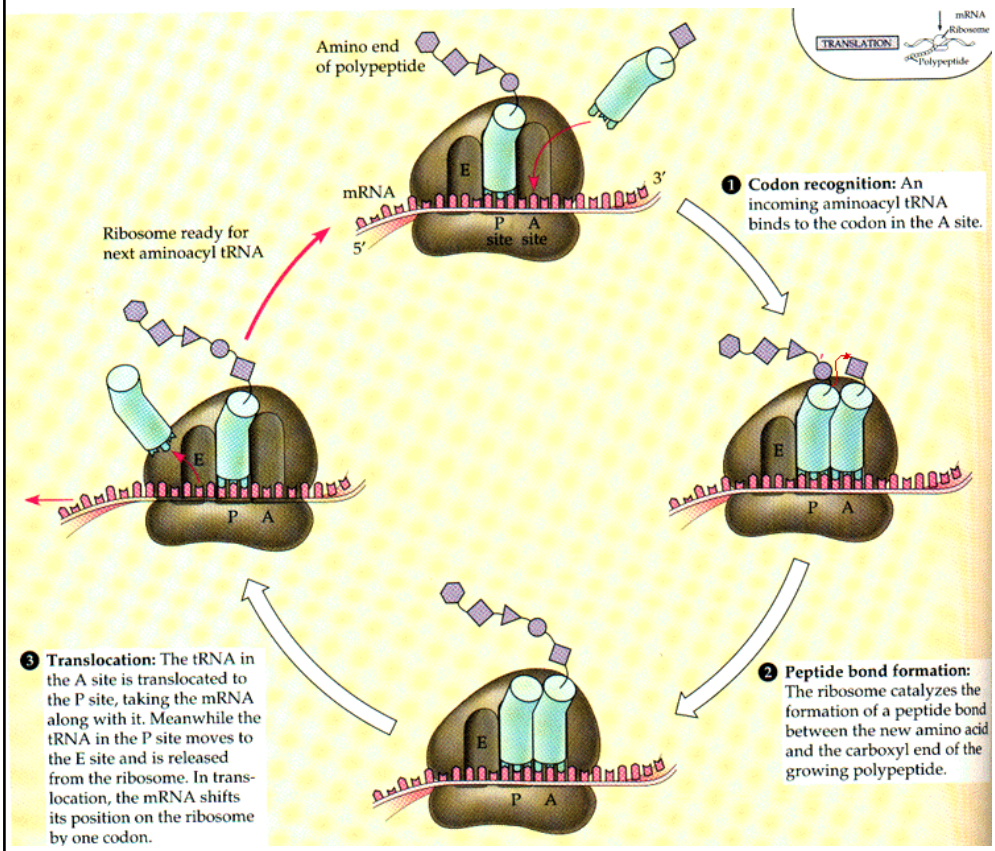
- tRNA molecule brings amino acid and binds it to the mRNA codon. A second tRNA molecule will then approach.

- First tRNA molecule detaches after its codon is attached to the second tRNA's codon.

- Cycle repeats with the ribosome moving along the mRNA until the entire molecule is translated

http://www.youtube.com/watch?v=NJxobgkPEAo

Oct 1-9:01 PM



Oct 1-9:13 PM

Regulating Gene Expression

- a cell can regulate its gene expression partially in response to its environment.
  ex. Arctic foxes turn brown in response to polypeptides that are produced when the temperature warms.

- The following factors are known to affect the rate of transcription and translation in living cells:
  - changes in temperature or light
    ex. thicker fur coats, plants to germinate, etc.
  - presence or absence of nutrients in the environment
    ex. e. coli reacts to the presence of lactose in the environment by stimulating the production of more
  - presence of hormones
    ex. stimulate responses and proteins synthesis in the cell

Oct 1-9:15 PM

Mutations

A permanent change in the genetic material of an organism

Only mutations found in germ cells are heritable to future generations - will be copied during DNA replication

Types of Mutations:

1) Point mutation - a chemical change that affect only a few nucleotides (ex. insertion or deletion of a nucleotide)

2) Silent mutation - no effect on the cell's metabolism

3) Mis-sense mutation - can be harmful (change in an amino acid) or beneficial (develop a new protein that can helps an organism thrive)

Oct 1-9:36 PM

Causes of Mutations

Mutations that are caused by agents outside the cell are said to be induced. A substance or event that increases the rate of mutations is called a mutagen.

Mutation Causes -

1) Spontaneous mutations - naturally occurring mutations in the cell.
   - ex. incorrect base pairing

2) Physical mutagens - agent (ex. X-rays) that can forcibly break a nucleotide sequence causing random changes in one or both strands of a DNA molecule

3) Chemical mutagens - molecule that can enter the cell nucleus and cause a permanent change to the DNA of the cell

Oct 1-9:56 PM